Rice University
Civil and Environmental Engineering

CEVE 518 – ENVIRONMENTAL HYDROGEOLOGY

FALL 2019 Syllabus

Course objectives

1. Develop an understanding of the basic equations of groundwater flow and contaminant transport, and how to apply them to real-life problems.
2. Understand how physical, chemical, and biological processes that affect chemicals as they are transported through the environment.
3. Understand the limitations in data and our ability to accurately predict groundwater flow and contaminant transport.
4. Learn how to assimilate diverse and sometimes sparse information to draw conclusions about contamination issues through homework problems and a class project.
5. Learn the potential of groundwater and vadose zone modeling software.

ABET Program Learning Outcomes Contribution

Learning Outcome	Course Contribution (Scale 1 to 5)
1. ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	5
2. ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	5
3. ability to communicate effectively with a range of audiences	4
4. ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	4
5. ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	4
6. ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	4
7. ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	3

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Textbooks

Required:

Charbeneau, R.J., *Groundwater Hydraulics and Pollutant Transport*, Waveland Pr Inc, 2006.

Highly Recommended:

Bedient, P.B., H.S. Rifai, and C.J. Newell, *Ground Water Contamination; Transport and Remediation, 2nd Ed.*, Prentice Hall, Upper Saddle River, NJ, 1999.

Other useful references:

Anderson, Mary P. and William W. Woessner, Applied Groundwater Modeling; Simulation of Flow and Advective Transport, Academic Press, Elsevier, San Diego, 2002.

Bear, Jacob, Dynamics of Fluids in Porous Media, Dover Publications, New York, 1972.

Bear, Jacob, Hydraulics of Groundwater, Mcgraw-Hill, 1979.

Crank, J., The Mathematics of Diffusion, 2nd Ed., Oxford University Press, Oxford, Great Britain, 1975.

Domenico, P.A. and F.W. Schwartz, *Physical and Chemical Hydrogeology, 2nd Ed.*, John Wiley and Sons, 1997.

Fetter, C.W., Applied Hydrogeology, 4th Ed., Prentice Hall, Upper Saddle River, NJ, 2001.

Fetter, C.W., *Contaminant Hydrogeology, 2nd Ed.*, Waveland Press Inc, 2008.

Freeze, R.A. and J.A. Cherry, *Groundwater*, Prentice Hall, 1979.

Pankow, J. F. and J. A. Cherry, 1996, Dense Chlorinated Solvents and Other DNAPLs in Groundwater, Waterloo Press, Portland, Oregon, 1996.

Spitz, Karlheinz and Joanna Moreno, A Practical Guide to Groundwater and Solute Transport Modeling, John Wiley and Sons, New York, 1996.

Strack, Otto D.L., Groundwater Mechanics, Strack Consulting Inc., North Oaks, MN, 1999.

Todd, D.K. and L.W. Mays, *Groundwater Hydrogeology*, 3rd Ed., John Wiley and Sons, 2004.

Zheng, Chunmiao and Gordon D. Bennett, Applied Contaminant Transport Modeling, 2nd Ed., John Wiley and Sons, New York, 2002.

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Grading

Tests (2)	50%
Homework	25%
Group Project Presentation	5%
Group Project Report	20%

Attendance at all lectures is expected and missing classes without prior notification will negatively impact your grade.

Exams

Two exams will be given:

- A closed-book in-class exam on or around October 10. You will be provided with a hand-out of important equations.
- A take-home, open-book, open-notes exam distributed on or around November 19 and will be due one week later, on or around November 26.

Selected exams from current and previous semesters and solutions will be posted on Canvas. Because the group project will be a significant effort, there will be no final exam.

Homework

Homework assignments will require significant effort on your part. They are designed to give you practice at applying the course material in a way that you probably will in your professional life after college. Homework assignments will generally be due 1 to 2 weeks after distribution. Assignments and solutions will be posted on Canvas. Grades on late homework assignments will be reduced by 10 percent of the possible homework grade for each day or part of day that they are late. Extensions can be given *with prior arrangement*.

Project

Project – Groundwater model exercise (group report). Project includes:

- Development of a conceptual model.
- Estimate of hydraulic parameters from data.
- Simulation of contaminant transport in the vadose zone.
- Construction and calibration of a saturated zone flow model.
- Construction and calibration of a mass transport model.
- Design of groundwater remediation system.
- Presentations (tentatively scheduled for last day of class: December 5).
- Report (also tentatively due last day of class: December 5).

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Instructor and Office Hours

Phillip C. de Blanc, Ph.D., P.E.
107 Mech Lab
Mobile: 281-635-6069 (“Emergencies” only please!)
Email: pcd1@rice.edu

Office hours by appointment.

I check email regularly, and you are encouraged to communicate by email whenever possible. I will usually respond within a few hours, but (almost) never more than 24 hours later (except on holidays and weekends).